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THE IMPACT OF THE EURO ON TRADE

THE (EARLY) EFFECT IS NOT SO LARGE

SERGIO DE NARDIS
AND
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ISBN 92-9079-415-1
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ABSTRACT

We investigate the impact of the euro adoption on commercial transactions of EMU countries. We refer to the abundant gravity-model literature about the effect of Currency Unions on trade originated by Rose (2000). We adapt this kind of modelling to the specific case of the European Monetary Union drawing from former literature some guidelines summed up as follows: distinction of "pure" common currency from exchange rate volatility effect; selection of sample of countries strictly focussed on EMU economies; consideration of time as well as space dimension; inclusion of other political factors promoting integration. We add to these provisions the observation that the panel estimation of the gravity equation must be dynamic, because EMU is a young phenomenon; short run effects, like trade persistence, can hence play a crucial role.

Our main finding is that the euro adoption has had a positive but not exorbitant impact on bilateral trade of European countries (the estimated percentage increase ranges between 2.6 and 6.3%), much lower than that derivable from Rose's estimates referred to a larger and heterogeneous set of countries (providing a trade increase following the adoption of a common currency by as much as 200%). Our results refer to short-run impacts; long-run effects could be stronger (but, in our opinion, not by the order of a doubling or a trebling effect indicated in the existing literature on currency unions), particularly if the structural change implied by the new currency regime (a fraction of foreign trade is potentially equivalent to domestic trade) becomes completely internalised in the perception and the behaviour of Euroland citizens.

JEL Classification No. F4; F15; C230. Keywords: Bilateral, Economic Integration, Dynamic Panel data.

* ISAE, Rome. This paper is being published simultaneously as ISAE Working Paper No. 31/03.

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1. Introduction

As widely discussed in the literature on monetary unions, the elimination of national currencies and their replacement with a single (international) currency lead both to benefits and costs to countries that give up their currencies and their independent monetary policies. The degree of optimality of currency areas depends on the structural characteristics of member economies. While the costs are essentially related to the loss of an important source of adjustment to asymmetric shocks, the benefits mainly come from potential gains in economic efficiency, several of which derive from the elimination of transaction costs, associated with the use of different currencies, and uncertainty deriving from fluctuations of exchange rates.

As a side effect of the adoption of a common currency, many observers also expect a boost to the volume of trade among member countries. The argument generally goes as follows: transaction costs and, especially, currency risks constitute a barrier to trade by dampening the volume of exchanges of goods and services that would otherwise take place. Hence, eliminating these costs and exchange-rate variability with the introduction of a single currency produces an expansion of cross-border transactions and deeper integration in the monetary area.

This view, although widespread, is not undisputed among scholars of monetary unions. In particular, sceptics point out that, even in a turbulent currency environment, there are several financial instruments that allow exporters and importers to hedge against exchange risks, so that the potential increase in trade coming from the elimination on national currencies, is at best small. The counter argument, is that hedging against exchange rate risks cannot be complete and is, costly, especially for small-size exporting firms that typically do not have access to sufficiently developed financial services in order to efficiently manage the risk in currency markets.

These disputes, focused exclusively on the abatement of the variability of exchange rates, may miss the most relevant point in the analysis of the trade effects of currency unions. In fact, the elimination of uncertainty is only part – and probably not the most relevant part – of the story. The same result could be equally obtained through a credible regime of fixed exchange rates. A currency union is, qualitatively, a different thing. It entails a modification of the perceptions and expectations of economic agents who end up dealing with an institutional arrangement whose degree of transparency (all prices across member countries are named in the same currency) and sense of irrevocability/commitment (breaking up a currency union is different to breaking up an exchange rate mechanism) is much larger than that in any fixed-exchange-rate regime. As a consequence of these important particularities, a significant fraction of the foreign trade of the countries adopting a common currency may become, in the eyes of economic agents, equivalent to domestic trade. In this perspective, discussions of the repercussions of monetary unions for trade acquire quite a different momentum.

This paper investigates the impact of adopting the euro on the commercial transactions of EMU countries, trying specifically to disentangle the effects attributable to the elimination of exchange rate volatility, and to other policy factors promoting integration, from the influence attributable to the emergence of the European monetary union. Section 2 surveys the empirical literature on currency unions and trade, largely developed over the past few years, to which our paper contributes and from which the main indications and methodological instruments for the analysis are drawn. Sections 3 and 4 expose the characteristics of the model adopted. Illustration and discussion of the results of the estimates are made in Section 5. Conclusions are reported in Section 6.

2. Currency unions and trade: A survey of the empirical literature with an eye to the EMU

Despite a widespread conviction that exchange rate volatility dampens trade, scant empirical evidence has been produced to support this view, until the mid-nineties. The results of these older studies generally showed a relationship between exchange rates and trade either with the "wrong" sign (e.g. Brada and Mendez ,1988), or statistically insignificant (e.g. Belanger et al., 1992) or at best weak (e.g. Frankel and Wei, 1993).

Given the rather inconclusive state of the literature, great attention was paid at the beginning of this decade to the seminal work of Rose (2000) who – using a gravity model to look at the effect of a common currency as distinct from that of exchange rate variability – found an extremely large positive impact of currency union on trade. According to his estimates, two countries sharing a common currency trade three times as much as they would with different currencies. Such a striking result remained substantially unchallenged in a set of subsequent sensitivity analyser aimed at checking the robustness of the finding to different specifications and methods of estimating the basic equation (Rose, 2001; Frankel and Rose, 2001; Rose and Engel, 2000).With the goal of testing the effect on trade of the most ambitious experiment of currency union ever tried – since the EMU is such an experiment – the obvious question is to what extent these findings are relevant to the consequences of the euro on the transactions between Euroland economies. Quite disappointingly, the answer is "not much". Although there is no benchmark from the literature, the size of the effect proposed in this new vintage of studies (a threefold impact!) seems implausibly large in general and in particular for the EMU countries.

Starting with the general implausibility of the effect, several authors have criticised these findings[1] from different points of view and tried to obtain (among them, Rose himself) lower estimates. We go through this literature with a special eye to the EMU case, picking up the contributions that seem most promising in shedding light on how to proceed in detecting the impact of the euro – a more limited case (and a special case as we will see) than the common currency effect considered by Rose.[2] In what follows, we try to single out some directions or routes that may prove useful in subsequent analysis.

Heterogeneity of the sample countries

The sample of countries in the dataset of Rose (2000) was extremely heterogeneous. It included 186 countries, dependencies, territories, overseas departments, colonies and so forth:

[1] See, for example, Lockwood (2000) and Quah (2000), the report of the general discussion on Rose (2000) and Persson (2001).

[2] Limiting the field of observation to the euro area only, we avoid some of the criticism to Rose's works, like those concerning the aggregation bias (see Levy Yeyati, 2001). For a recent survey of the empirical works on the topic of monetary union, see Rose (2002).

there were a number of currency unions, comprising one large and developed country with a number of much smaller countries or territories. It is a world completely different from that represented by the subset of European countries that gave rise to the European Monetary Union. As stressed by Lockwood (2000) and Rose (2000), it is not possible to extrapolate relevant information on the trade repercussions of the euro from this kind of sample.[3] We conclude from these observations that, to infer the impact of the euro on the transactions of EMU countries it is necessary to refer to a more narrowly defined sample around a core consisting of the Euroland economies.

Time versus spatial dimension

Rose (2000) exclusively focused on a spatial dimension. He estimated a gravity equation on a very large cross-section of countries. The high estimate of the common-currency parameter measures the variation of trade between member countries of a currency union with respect to trade between countries that maintain their national currencies. But, as underlined by Rose (2002), a time-series rather than a cross-section approach would allow us to address the more relevant policy issue of the measurement in the variation of trade of countries before and after the creation (or the destruction) of a monetary union. In fact, this is precisely the issue we want to deal with when testing the consequences of the very specific and (to now) short-lived currency union that is the EMU. However, not to loose the equally important information conveyed by the spatial dimension, the best strategy to follow seems to be, even in the case of EMU, resorting to panel estimations.

Working with panel estimates generally allows us to treat all the time-invariant (but space-variant) factors properly. Rose (2000), working on cross-section data, considers a set of space (geographical, cultural and historical) factors that are actually independent of time. Yet, in spite of the many time-invariant variables one adds to the regressors, there always remains the possibility of omitting some which are difficult to proxy, thus running the risk of a spurious regression. Conversely, in the case of panel estimation, a fixed-effect method allows us to control for all the possible time-invariant factors specifically affecting the bilateral trade in each pair of countries, including those factors for which it would be impossible to find an explicit approximation[4].

Rose (2000)[5] noted that a fixed-effect estimation would in many ways be preferable to estimation techniques based on cross-sectional evidence. The small number of regime

[3] This is for example a criticism carried out by Lockwood (discussion on Rose, 2000), but Rose himself said that "In 330 observations two countries trade and use the same currency. Many of the countries involved are small, poor, or both, unlike most of the EMU-11. Thus, any extrapolation of my results to EMU may be inappropriate since most currency union observations are taken from countries unlike those inside Euroland", see Rose (2000), p. 15.

[4] Besides, the fixed-effect estimation also allows to avoid a number of problems of mis pecification created by the measure of geographical distance. This problem is well known in empirical works adopting gravity equation. Distance can be a poor measure of transport costs. Usually, it is measured by miles or kilometres between two single points, i.e. the capital cities, under the implicit assumption that all citizens concentrate in the capital; trading costs are quite different if people are spatially distributed within the country. Recently, Melitz (2001) has demonstrated that a measure of distance can reflect comparative advantages. The latter depends on differences in climate and seasons, factors that are simply reflected in differences in latitude between countries. If this holds true, it is not clear which sign is expected for this variable: an increase in distance might raise, not diminish, trade, if differences in comparative advantage prevail. A fixed-effect estimation allows to bypass this kind of problems, including distance in bilateral constant term.

[5] See Rose (2000).

changes in his data (countries entering or leaving common currencies) did not enable him to adopt this method[6].

Resorting to a different dataset – a panel whose time series go back to 1948 – and to a modified specification of the gravity equation, Glick and Rose (2002) obtain, with a fixed-effect method, a reduction of about one third of the original estimate of a threefold increase in trade.

Distinguishing common currency from other "political" effects

Lower and more plausible estimates of the trade effect of a common currency require a sharp separation of the currency union from other political factors whose influence on trade may become confused with that of the single-currency. Melitz (2001), using the heterogeneous dataset of Rose (2000) and making a distinction between the different political effects, came to a lower quantification of the impact of currency union – it would raise trade by a factor of two (rather than three). This result was basically obtained by distinguishing a Political Union and Free Trade area from the currency-union effect. The rationale for this differentiation is fairly obvious: in general, countries that tend to form a monetary union already enjoy particularly close trade or political ties. When not controlling for these links, much of the coefficient on a currency union variable is likely to catch the influences attributable to other political factors.

In the already-mentioned study, Glick and Rose (2002) separated a "*within*" from a "*between*" estimate for the impact of common currency. The former relates to the effect of entry into (or exit from) currency union for specific country pairs, while the latter concerns cross-section or different pairs. Although the former does not mix up a currency union effect with political-ties or close-trade effects, the latter can be supposed to do so. The results of the "*within*" estimate showed a smaller influence of currency (a twofold increase of trade), in line with the findings of Melitz (2001).

Rose and Van Wincoop (2001) considered the cases of new currency unions between countries that already trade a lot with each other, as in the case of EMU economies. Introducing a multilateral-trade-resistance index, drawn from Anderson and Van Wincoop (2001), which varies positively with the intensity of trade barriers between each country and with all its trading partners, the authors estimate an increase of "only" 59% in trade between Euroland members: a significantly smaller impact than previous estimates, but, still, a large effect.

3. Short-term dynamics in Euroland trade: The "persistence effect"

From the preceding discussion we can extract four main guidelines for our work:

1) a distinction must be made between euro adoption and exchange rate variability effects, since the former should have different implications for economic agents' behaviours;
2) the sample of countries has to be selected by focusing on the group of economies that entered EMU, so that this case is adequately weighted in the whole sample;

[6] Probably for this reason, the results addressed by Pakko and Wall (2001) might be biased. In fact, they start from the original dataset adopted in Rose (2000); using trading pair specific fixed effects to control for time-invariant factors, they show an opposite result: a common currency may lead to significant reductions in trade; indeed, this result is statistically insignificant. The authors point out that "..the pooled cross section estimates are not reliable because they are biased by the exclusion or mismeasurement of trading pair-specific variables". This is probably true, but the original Rose's dataset shouldn't permit to apply this estimation method.

3) time as well as space dimensions must be included so as to address the most relevant policy issues, provided the time dimension includes enough years of euro experience;

4) account must be taken of the political and economic ties between Euroland economies that pre-existed or accompanied the formation of EMU and gave rise to an increase in the share of intra-area trade.

Before addressing estimation issues, a further observation should be added to the guidelines in order to better adapt the findings of the literature to the specific monetary union we are dealing with. When considering the time dimension, one should not forget that EMU is a recent phenomenon. The European single currency replaced the member countries' national currencies on January 1, 1999, even though only in a "virtual" form.[7] Taking into consideration that "irrevocable" decisions concerning the "euro club" founding members, their exchange rates and their macroeconomic policies were taken in 1997, at best it is possible to scale the beginning of the influence of the (future) new common currency back to 1998. Given the novelty of EMU, traditional static gravity models, that generally deal with long-run relationships, are not well suited to interpreting the repercussions of the euro. To this end, we need to make the gravity equation more short-run oriented, by explicitly introducing dynamics, controlling for the lagged effects of the dependent variable and detecting the short-term influences of the euro and of all other variables affecting bilateral trade in Euroland.

Indeed, the "short run" can generally be highly relevant in trade analyses, since countries that trade a lot with each other tend to keep on doing so. Such inertia mainly derives from the sunk costs exporters have to bear to set up distribution and service networks in the partner country, leading to the emergence of substantial entrance and exit barriers (see Eichengreen and Irwin, 1996). This sticky behaviour seems all the more important in the case of EMU, where trade relationships are affected not only by past investment in export-oriented infrastructures, but also by the accumulation of invisible assets such as political, cultural and geographical factors characterising the area and influencing the commercial transactions taking place within it. It is worth noticing that, notwithstanding the general importance of the "persistence effects", quite a few studies, based on a panel estimation of gravity equations, have considered the possibility of controlling for them (see Egger, 2000, De Grauwe and Skudelny, 2000; Bun and Klaassen, 2002)

4. Model and dataset

The estimation methodology adopted is hence a dynamic panel data approach. We consider 11 exporter countries (European countries now joining the euro, data for Belgium and Luxembourg aggregated) and 30 importer countries (the 11 euro countries plus 19 other countries[8]). The estimation is carried out on data for the period 1980-2000.

The introduction of dynamics in a panel-data model raises an econometric problem. If trade is a static process, the "*within*" estimator (fixed-effect estimator) is consistent for a finite time dimension T and an infinite number of country-pairs N. But if trade is a dynamic process, the estimate of a dynamic panel such as our model (a static one with the lagged dependent variable) is more difficult. The reason is that the transformation needed to wipe out the country-pair fixed effects[9] leads to correlation between lagged dependent variable and the

[7] The single currency was officially introduced on January 1, 2002.

[8] They are: Argentina, Australia, Brazil, Canada, China, Czech Republic, Korea, Hong Kong, Japan, Mexico, Norway, Poland, Romania, Russia, Sweden, Switzerland, Turkey, United Kingdom, United States.

[9] The "*within*"estimator consists of removing the country-pair effects by taking deviations from country-pair means and then applying least squares on the centered variables.

transformed error term that (for a finite T and an infinite N) renders least square estimator biased and inconsistent.

There are alternative estimators to bypass this inconsistency problem[10]. We focus on that proposed by Arellano and Bond (1991). They suggest transforming the model into first differences and using the Hansen two-step generalised method of moments (GMM) estimator. First differencing the equation removes the random effects that are independent and identically distributed over the individuals, and produces an equation that is estimable by instrumental variables.[11]

We are interested in distinguishing the "pure" currency union effect on trade from other political effects (free trade area, exchange rate volatility) that are specific to the case of EMU. To this end, two distinct monetary variables were considered: a measure of exchange rate volatility and a dummy variable for countries that adopted the euro.[12] Our assumption is that countries sharing the same currency have an additional positive effect on trade with respect to countries sharing a fixed-exchange-rate regime. *De facto,* the assumption is that a common currency can affect trade by the elimination of exchange rate volatility and by another, different, influence. We might call this a "currency union" effect, which includes a structural change in the perception of agents due to the irreversible choice of adopting a common currency.[13] Since exchange rate volatility between Eurozone countries was reduced during the last decade thanks to the EMS and, lately, due to the convergence process leading to the common currency, the distinction between the two effects seems important. Besides, the specific effect on trade from bilateral free trade agreements is taken into account by introducing a dummy variable.

The estimated equation is:

$$\Delta Ln(Exp_{ijt}) = b1\ Ln(Exp_{ijt-n}) + b2\ \Delta EURO_{ijt} + b3\ \Delta VOL_{ijt} + b4\ \Delta FTA_{ijt} + b5\ \Delta ln(MASS) + b6\ \Delta RFE \quad (1)$$

where:

ln is the natural logaritm, *i* is the exporter country, *j* is the importer country and *t* is the year, *n* is a lag structure for the dependent variable.

Exp_{ijt} are the exports in volume from country *i* to country *j*.

$EURO_{ijt}$ is a dummy variable describing the adoption of the same currency by the 11 European countries. It takes value 0 for trade between all the pairs of countries in which at least one is not member of EMU, and value 1 for trade between Eurozone countries from 1998 to 2000. In doing this, we assume that the euro started to exert its influence in 1998, before its actual introduction, after decisions were taken (in 1997) about the countries entering the union and endorsing the commitments on exchange rates and macroeconomic policies.

[10] See Baltagi (2001).

[11] Arellano and Bond (1991) identified how many lags of the dependent variable and of the pre-determined variables were valid instruments and how to combine these lagged levels with first differences of the strictly exogenous variables into a potentially very large instrument matrix.

[12] Considering that countries decided to join the single currency in May 1998, we consider that year as the start of the common currency period.

[13] "Sharing a common currency rate is much more serious and durable commitment than a fixed rate", see Rose (2000), pp. 10-11.

VOL_{ijt} is the exchange rate volatility between countries *i* and *j* at time *t*; it has been measured by the standard deviation of the first-difference of monthly natural logarithm of the bilateral nominal exchange rate at the current year *t*.

FTA_{ijt} is a dummy variable that assumes value 0 for absence of free trade agreement or custom unions, 1 if these agreements are present.

MASS is the bilateral real GDP of a country pair, as in traditional gravity applications, where MASS= $\ln(GDP_{it} \times GDP_{jt})$.

GDP_{it} is the gross domestic product in volume of exporter country, GDP_{jt} is the gross domestic product in volume of importer country;

RFE is an index for relative factor endowments, proxied by *per capita* GDP (GDPPC). The index takes the following form: $RFE = |\ln(GDPPC_{it}) - \ln(GDPPC_{jt})|$ with $RFE \geq 0$; The index takes its minimum for countries with identical factor endowments.

The sources of these variables are showed in Table A1 in the Appendix.

Bilateral export flows were expected to be positively influenced by:

a) the euro effect. We expect a positive effect of the euro adoption on trade. Considering historical trade relationships between European countries, we expect a smaller impact compared to Rose's results.

b) the product of GDPs of exporter and importer countries (i.e. the sum of their values expressed in logs). In gravity models, trade flows are positively influenced by the dimensions of the origin and destination countries ("mass effect"), proxied by GDP.

c) the presence of customs unions or bilateral free trade agreements. Considering all the European countries joining the euro, the implementation of a Single Market should have caused an important effect on bilateral trade within the area. On the other hand, in the period under examination, European countries have signed regional trade agreements with most non-European countries in our dataset. We expect an economically large impact on trade from this variable.

d) the lagged endogenous variable. Trade relationships between industrialised countries and, in particular, among European countries, have been characterised by very tight economic and political links. We expect that countries trading a lot with each other continue to do so, thus reflecting entrance and exit barriers due the sunk costs.

Bilateral export flows were expected to be negatively correlated:

e) with the exchange rate volatility indicator. We expect an increase in bilateral trade when uncertainty regarding bilateral exchange rate fluctuations diminishes[14].

f) with the RFE index. This index is a proxy of differences in factor endowments: a negative correlation with bilateral trade indicates that countries with similar levels of development (small value of the index), like those in our sample, trade a lot, reflecting the importance of intra-industry trade; the correlation could be positive if the sample included economies characterised by very different levels of development and predominance of inter-industry trade.

[14] Among more recent works, also De Grauwe and Skudelny (2000) find a negative relationship between the variance of nominal exchange rate and trade.

5. The results

Arellano and Bond (1991) propose a test of the hypothesis that there is no second-order serial correlation in the disturbances of the first differenced equation. This is a necessary condition for a valid instrumentation, if it is confirmed, then the GMM estimator is consistent. A test for the hypothesis that there is no first order serial correlation is also reported: the rejection of the null hypothesis (i.e. the presence of first order serial correlation) indicates the inconsistency of the OLS estimator.

Table 1 reports the results of these tests and the estimates of the equation by the Arellano-Bond procedure. The tests show the consistency of the GMM estimator and the inconsistency of the OLS procedure. Hence, by introducing dynamics, the proper estimation method is the former[15]. A test of over-identification (Sargan test) is also reported: the statistic suggests that the hypothesis that all moment restrictions are satisfied for dynamic specification is not rejected at 5% significance level.

All the regressors are statistically significant and show the expected sign. In particular, the positive impact of adopting the euro is confirmed, as is the negative influence of bilateral exchange rate volatility and the positive effect of being part of a free trade agreement.

Let's have a closer look at the three different kinds of "political" influences (so defined because their values depend on political decisions). As currency variability, a hypothetical reduction of exchange rate volatility between Euroland countries and their partners by one standard deviation around its mean would increase total bilateral trade of Eurozone countries by around 4%.[16] Belonging to a free trade area or to a customs union increases total exports of the Eurozone countries (on average) by 17%.[17] After controlling for these two factors, the "pure" effect on total EMU trade produced by euro adoption is an increase of 6.3%,[18] since no other country in our sample is a member of a monetary union, such an effect ends up coinciding with the increase of intra-EMU trade following the euro introduction. This result

[15] Bun and Klaassen (2002) show that trade is a dynamic process and that panel gravity models should allow for that; they also show that, for a T large, the LSDV estimator is a better tool than the GMM one. In other words, there is a consistency problem but also a bias problem. For T large, the bias of the GMM estimator is higher than that of the OLS one. In their sample T=48, we have a T=21. It is well known that the bias increase when T becomes smaller. For a smaller T than in the Bun and Klaassen dataset, the bias will be higher for both estimators. We are interested to the relative bias. We know that finite sample bias of the GMM estimators increase as the number of momentum conditions gets larger, in other words, as T gets larger. It is reasonable to suppose than for a T smaller than the Bun and Klaassen dataset, the bias of the GMM will be lower than their figure and the bias of the OLS estimator is higher. To evaluate with more precision the accuracy of the estimators, a Monte Carlo experiment should be performed.

[16] We perform the same simulation exercise proposed by Rose (2000). It consists of reducing VOL, the variable measuring the exchange rate volatility, by an amount equal to its standard deviation. Being the standard deviation of VOL 0.137295 (with a mean of 0.6435) and the estimate of its parameter –0.2887, the increase of trade following the fall of VOL by its standard deviation, i.e. $[(EXP_{\text{reducing VOL by one standard deviation}}/EXP)-1]x100$, is given, *coeteris paribus*, by $[(e^{-0.2887x(VOL-0.1372)}/e^{-0.2887xVOL})-1]x100$ and therefore by $[e^{(-0.2887)(-0.1372)}-1]x100$; since $e^{(-0.2887)(-0.1372)}=e^{0.03964}$ = 1.0404, the increase in bilateral trade following a reduction of volatility from one standard deviation to zero is around 4%.

[17] Since the parameter of the dummy FTA is 0.1577, the variation of trade induced by being part of a trade agreement (FTA=1) with respect to the case of not being part of any agreement (FTA=0), i.e. $[(EXP_{\text{being part of a trade agreement}}/EXP_{\text{not being part of ay trade. agreement}})-1]x100$, is given, *coeteris paribus*, by $[(e^{0.1577x1}/e^{0.1577x0})-1]x100=17.09\%$.

[18] This result coincides with the average increase of intra-EMU trade both with respect to all countries that are not part of EMU and with respect to the trade of the EMU countries themselves considered before the creation of the monetary union. For the calculation method, see note 17.

seems more reasonable than the previous ones obtained on the grounds of quite heterogeneous samples of nations.

On the whole, the estimated parameters seem to confirm our priors: the adoption of a common currency had a positive but not exorbitant impact on the bilateral trade of European countries. This is probably because trade links were already well established for several reasons. Trade relationships within Europe, historically strong for cultural and proximity factors, were reinforced during the past 20 years by several (partially overlapping) policy decisions such as the creation of the European Monetary System at the end of the 1970s, the institution of the Single Market in the 1980s, the adoption of the euro at the end of the 1990s. Taking the estimates of the policy parameters at their face value, one is led to attribute the largest impact on EMU transactions to the implementation of the Single Market (though the estimated effect also includes the influence of minor bilateral trade agreements with third countries outside Europe concluded in that period). The impact of the FTA dummy on trade is significantly higher than that of the EURO dummy and that of exchange rate volatility.[19]

The lagged dependent variable is statistically significant until a 3-period lag; the value of the coefficient shows the importance of the "persistence effect". The other "gravity" variables are generally in line with the expectations and tradition of this kind of modelling. Trade directly varies with the size of importers and exporters and indirectly with the differences in *per capita* GDP of trading economies. The latter evidence seems to confirm the prevalence of intra-industry trade between industrialised countries.

The impact of the euro on the EMU trade, obtained in this estimation, measures the variation of transactions of EMU economies with respect to:

1) transactions with non-member countries;
2) transactions of EMU countries themselves before they entered the "euro club". Such a variation has hence both a spatial and a time dimension, with the complication that the latter includes a comparison with both EMU economies (for which there is a change in the currency regime in 1998) and non-EMU countries (for which there is no change in currency regime during the relevant time interval).

To have an evaluation of the effects of the euro on intra-EMU trade before and after the adoption of the single currency, we have re-estimated equation *(1)* considering a sub-panel which consists only of EMU variables; hence, the dependent variable in this estimation is represented by intra-EMU exports. Results are shown in Table 2. Attention is drawn to the differences, compared with the estimation made on the whole panel, of the dimension of the so-called policy parameters (euro, Exchange rate volatility, FTA) and of the parameter of the lagged dependent variable. Starting from the latter, the lagged dependent variable shows a higher coefficient than in the complete-panel regression. This probably reflects the structurally tighter intra-area trade links that are mirrored in a higher degree of inertia in trade flows.

Conversely, coefficients of the policy parameters favouring integration generally lead to smaller impacts than in the complete panel-regression case. This may be explained by the fact that variations are measured with respect to a "base" already characterised by a significant degree of commercial integration, higher than that denoting the larger panel. As for exchange rate volatility, the larger dimension of the parameter than in the previous estimate is more than offset by the lower variability of the variable, so that the impact of a currency volatility

[19] It is worth noticing that the dimension of the exchange rate volatility parameter is in line with that found by De Grauwe and Skudelny (2000) in their first difference estimation.

reduction gives rise to a very modest gain in intra-area trade. A fall in volatility by one standard deviation around its mean would have increased on average intra-EMU trade by 0.8%.[20] This kind of exercise is counterfactual: it gives an indication of "what it would be like" compared to "what it actually is". In the case of EMU countries, bilateral exchange rate variability has been much lower than general volatility (in our panel it has been lower by a factor of 12), mainly because of the EMS and, more recently, the process of macroeconomic convergence to meet the criteria to enter the monetary union. Given this evolution, the extra gain in trade from a further fall of exchange rate variability is necessarily limited.

As far as the FTA dummy variable is concerned, in the EMU sub-panel it basically reflects the progressive enlargement of the European Union to include new countries. Compared with the large- panel regression, the parameter dimension shows a smaller impact (by a factor slightly less than 3): according to this estimate, the effect on intra-area trade is 6.1%.[21]

Finally, the coefficient for the EURO dummy is positive and statistically significant. Also in this case, the magnitude of the parameter is lower than in the estimate conducted on the complete panel. The adoption of the common currency, controlling for all other factors, would have induced an intra-area trade increase of 2.6% with respect to the previous period.[22] This figure compares with the one obtained in the estimate conducted on the large panel (6.3%), which included both the time-dimension impact referred to, plus the intra-EMU trade and the space-and-time-dimension effect relative to trade with non-EMU countries.

6. Concluding remarks

The goal of this paper is to estimate the impact of the euro adoption on trade of EMU countries. To this aim we referred to the gravity-model literature originated by Rose (2000) which has provided estimates of the rise of trade due to the emergence of a currency union by a factor varying between 1.6 (i.e. 60%-increase) and 3 (i.e. 200%-increase). These figures seem to be implausibly large, even considering the lower end of the range, for the EMU case.

To adapt the gravity model to the specific case of the European Monetary Union, we draw some general guidelines from the literature that can be summed up as follows:

- distinction of "pure" common currency from exchange rate volatility effect;
- sample of countries strictly focussed on EMU economies;
- time as well as space dimension;
- consideration of other political factors promoting integration.

We add to these provisions the observation that the panel estimation of the gravity equation must be dynamic, because EMU is quite a young phenomenon, where short run effects, like trade persistence, may play a crucial role; this is particularly the case for European economies where persistence in commercial transactions is not only induced by physical investments in distribution and service networks, but also favoured by such "intangible" factors as policy, history and culture.

We performed two kinds of estimations to quantify the euro effect on the EMU trade. In the former, we calculate the variation of EMU trade with respect to both intra-EMU trade before

[20] The standard deviation is 0.01168 (with simple mean 0.00452) and the estimate of the coefficient is –0.6832; for the calculation method, see note 16.

[21] For the calculation method, see note 17.

[22] This result represents the increase of intra-EMU trade with respect to the situation of intra-area transactions before the adoption of the common currency. For the calculation method, see note 17.

the introduction of the common currency and the EMU trade with other economies that do not share the European currency. Other things being equal, the euro causes an EMU trade increase by 6.3%; since the sample only includes the EMU case as monetary union, this rise coincides with an increase of intra-EMU trade. With the latter estimation we aim at exclusively detecting the variation of intra EMU-trade before and after the euro adoption. Not surprisingly, the more limited scope of the exercise leads to a lower impact estimate: this mainly depends on the fact that the trade variation is measured with respect to a "base" characterised by an already high degree of trade integration (i.e. intra-EMU commercial transactions). According to this latter estimate – other things being equal – the euro has induced an increase of intra-EMU trade by 2.6% with respect to the behaviour of this kind of trade in the period before euro adoption.

In conclusion, the order of magnitude of the positive euro effect on EMU trade that we have obtained seems more plausible than the (very large) measures proposed in a literature not specifically focusing on the EMU experience. Since we deal with dynamic panel estimation, our results mainly refer to short-run impacts; long-run effects might be stronger (but in our opinion this is unlikely), particularly if the structural change implied by the new currency regime (intra-EMU trade is now equivalent to domestic trade) becomes completely internalised in the perception and the behaviour of Eurozone citizens.

Table 1. Estimation results

Dependent variable: Total-EMU countries' bilateral exports

Time period: 1980-2000

Lnexp	Coef.	Std. Err.	z	P>|z|	[95% Conf. Interval]	
EXP_{IJT-1}	.3791956	0.021174	17.91	0	0.337695	0.420697
EXP_{IJT-2}	.059718	0.014563	4.1	0	0.031174	0.088262
EXP_{IJT-3}	.0313784	0.012558	2.5	0.012	0.006765	0.055992
VOL_{IJT}	-.2887072	0.043723	-6.6	0	-0.3744	-0.20301
MASS	.6711997	0.051214	13.11	0	0.570823	0.771577
RFE	-.1874568	0.094771	-1.98	0.048	-0.3732	-0.00171
FTA	.1577987	0.027919	5.65	0	0.103079	0.212519
EURO	.0610236	0.026971	2.26	0.024	0.008161	0.113886
_const	.0038835	0.003836	1.01	0.311	-0.00364	0.011402

Sargan test of over-identifying restrictions:

chi2(184) = 280.73 Prob > chi2 = 0.0000

Arellano-Bond test that average autocovariance in residuals of order 1 is 0:

H0: no autocorrelation z = -1.98 Pr > z = 0.0473

Arellano-Bond test that average autocovariance in residuals of order 2 is 0:

H0: no autocorrelation z = -0.12 Pr > z = 0.9063

Table 2. Estimation results

Dependent variable: Intra-EMU countries' bilateral exports

Time period: 1980-2000

LnexpEU	Coef.	Std. Err.	z	P>|z|	[95% Conf. Interval]	
EXP_{IJT-1}	0.638625	0.013505	47.29	0	0.612155	0.665095
VOL_{IJT}	-0.6832	0.102555	-6.66	0	-0.88421	-0.4822
MASS	0.521753	0.022367	23.33	0	0.477915	0.565591
RFE	-0.10094	0.025637	-3.94	0	-0.15119	-0.0507
FTA	0.059221	0.007416	7.99	0	0.044687	0.073755
EURO	0.025713	0.005209	4.94	0	0.015503	0.035922
_const	0.000895	0.000273	3.27	0.001	0.000359	0.001431

Sargan test of over-identifying restrictions:

chi2(189) = 1840.22 Prob > chi2 = 0.0000

Arellano-Bond test that average autocovariance in residuals of order 1 is 0:

H0: no autocorrelation z = -6.29 Pr > z = 0.0000

Arellano-Bond test that average autocovariance in residuals of order 2 is 0:

H0: no autocorrelation z = -0.46 Pr > z = 0.6439

ANNEX 1

Table A1

Variables	Source	Available years
Bilateral exports flows (US million $)	International Monetary Fund, Direction of trade statistic database	1980-2000
Export deflator	Economist Intelligence Unit	1980-2001
GDP at constant price (billion US $ at 1996 prices)	Economist Intelligence Unit	1980-2001
Free Trade Agreement	WTO, Mapping of regional Trade Agreement, available at http://www.wto.org/english/tratop_e/region_e/region_e.htm	1980-2001
Bilateral exchange rate	International Monetary Fund, International Financial Statistic database	1980-2001
GDP per head (US $ at PPP)	Economist Intelligence Unit	1980-2001

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ENEPRI publications are partially funded by the European Commission under its Fifth Framework Programme - contract no. HPSE-CT-1999-00004.

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